Lippia, *Phyla canescens*, an increasing threat to agriculture and the environment

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Summary  Lippia, *Phyla canescens* (Kunth) Greene is a native forb of South America and is now widely distributed across the world. Lippia is present in all mainland states of Australia, except the Northern Territory. It is often confused with *P. nodiflora* (L.) Greene, but this species prefers tropical and sub-tropical areas. Lippia is now a major weed of floodplains within the Murray-Darling Basin (MDB). Recent concern about lippia led to the formation of the Murray Darling Lippia Working Group and an assessment of lippia within the MDB that was supported by the MDB Commission. Lippia currently infests 5.3 million ha of the MDB and this is predicted to increase following recent floods. It is estimated to cost the grazing industry $38 million p.a. and have an environmental cost of $1.8 billion p.a. It is a major threat to biodiversity and riparian areas. Current pasture management practices fail to limit the expansion of lippia. Cultivation is useful, but it poses a high erosion risk for floodplains. There are no effective management strategies for lippia in riparian areas. It is essential that research into biological control and other management strategies commence immediately, in conjunction with awareness and education programs, to halt the spread and help manage this very aggressive weed.

Keywords  Weed, taxonomy, production costs, environmental costs, spread, impacts, distribution, Murray-Darling Basin.

INTRODUCTION

Lippia, *Phyla canescens* (Kunth) Greene, is an introduced plant invading floodplain plant communities especially in the upper Murray-Darling Basin (MDB). It is an intractable weed that does not generally respond to herbicide or grazing management, though it is managed by cultivation. Lippia is increasing its distribution, density, and cover, and is having a significant impact on conservation and grazing systems, and rural land values. This paper is intended to raise awareness to lippia by describing the weed and key outcomes from recent studies of its distribution and impact in the MDB.

BIOLOGY, FORM AND WEEDINESS

Lippia is a prostrate perennial herbaceous plant. It develops a deep tap-root, 50–80 cm deep, extensive fibrous roots, and creeping stems to one metre long that root at the nodes. Flowers, in spring to autumn, are small and whitish on dense flower heads 5–10 mm diameter, on an axillary stalk 15–45 mm long. Fruits are 1–1.5 mm diameter and contain two very small seeds. Reproduction is through seed germination and rooting of stem nodes. Dispersal is primarily by water for both seed and plant fragments.

Lippia favours temperate and sub-tropical areas and occurs over a wide variety of soil types in open seasonally wet areas and along edges of water bodies (Kennedy 1992). In Australia its distribution is New South Wales (NSW), Victoria, southern parts of Queensland (Qld), South Australia (SA) and Western Australia (WA). It is well adapted to the heavier clay soils typical of the upper MDB but not confined to them.

Lippia seems to have had very limited herbal or medicinal use, and has limited palatability for cattle. It is used as a lawn species and as an ornamental ground cover.

The scrambling growth and deep tap-root provides lippia with a competitive edge. It is drought resistant and when favourable growing conditions occur its tangled mats of stems and leaves cover the ground smothering or excluding other plant species. Allelopathic effects may also be a factor in its apparent dominance (Elakovich 1987, Lucy et al. 1995).

Lippia invades and dominates areas that are not cultivated including perennial pastures, riparian areas, and roadsides. It contributes to deep soil drying leading to bank slumping and erosion especially in cracking clays, resulting in damage to diversion banks, dam walls and roads. It is a lowland and wetland plant in its native range. In Australia it is generally regarded as a weed of riparian areas, wetlands and floodplains. However, recent observations suggest that it is becoming more prevalent in uplands (Earl 2003). Lippia thrives on frequent flooding of short duration.
Lippia replaces productive pasture species and reduces grazing productivity, in some cases necessitating total de-stocking. Conventional pasture management practices do not control this weed. The presence of lippia on a farm reduces the farm’s value because of the reduced productivity and cost of largely ineffectual controls (Lucy et al. 1995, Earl 2003).

TAXONOMY AND DISTRIBUTION

The naming of lippia in the literature is somewhat confusing as various combinations of Lippia, Phyla and Zanpania have been used with various species and sub-species and variety names, some of which are currently in use for recognised species, e.g. Phyla nodiflora (L.) Greene.

There are between nine (Kennedy 1992) and 11 (Munir 1993) species of Phyla recognised worldwide. The two species in Australia, Phyla nodiflora, and the weedy, Phyla canescens (lippia), are introduced (Munir 1993). All Phyla appear to be native to the Americas and the Caribbean (Kennedy 1992) and two, P. canescens and P. nodiflora, have been widely distributed to other continents.

Prior to Munir’s (1993) revision P. canescens specimens in Australia were identified as Lippia nodiflora, Lippia nodiflora var. repens, and Phyla nodiflora. Adding to the confusion, Australian weed texts continue to refer to the weed P. canescens as P. nodiflora.

Worldwide, lippia is recorded from the United States of America, Mexico, Australia, New Zealand, Guam, India, Afghanistan, South Africa, Algeria, Botswana, Egypt, Senegal, Spain, France and Italy. It is undoubtedly native to South America where it is recorded from southern Ecuador, Peru, Chile, Argentina, Uruguay, Paraguay, and Bolivia (Kennedy 1992).

The distribution of P. nodiflora and its close phylogenetic relationships with the other herbaceous Phyla species (Kennedy 1992) strongly suggests that this species is native to the tropical Americas and Caribbean. It has also been widely distributed around the world as an ornamental. P. nodiflora has a different set of requirements for growth than lippia and consequently it mainly occurs in the tropics and sub-tropics. In Australia it is found mostly in the Northern Territory and Qld but it also occurs in temperate coastal areas, south to Perth and Sydney (Munir 1993).

CURRENT SPREAD AND ESTIMATED COSTS IN THE MDB

Concerns about lippia led to a meeting in 2002 hosted by the Cotton CRC and the CRC for Australian Weed Management, and the formation of the Murray-Darling Lippia Working Group (MDLWG). Anecdotal evidence suggested that lippia was spreading and its impacts were becoming more and more significant. It was soon realised that an up-to-date study of the distribution and economic impacts of lippia was required to leverage resources to develop management strategies.

A study, commissioned by the MDLWG, funded by the Murray Darling Commission, aimed to: quantify current distribution of the weed, report on economic impacts in the rural sector and evaluate impacts on the environment.

The processes followed in the study were: information reviews, stakeholder interviews, focus group meetings, and field assessments. The results, estimates and conclusions should be of considerable concern to agriculturalists, environmentalists, natural resource managers and politicians, particularly in the MDB. A precis of the findings is given below. Details are in Earl (2003).

- Lippia is distributed across at least 5% or 5.3 million ha of the MDB. It is present in each of the 19 MDB catchments, some in very low densities. The worst affected are upstream catchments. Previous estimates of area were 600,000 ha (Lucy et al. 1995) or less. Figure 1 shows changes in estimated area of lippia in the Condamine. It was first recorded there in 1953 (Lucy et al. 1995) and the estimates suggest that lippia is in a phase of rapid expansion. Although similar time series estimates for other catchments are not available, lippia is much more widely distributed than previously thought. This seems due to recent rapid expansion, particularly in catchments that were already significantly infested. This is a warning to other areas where the weed is established or that it threatens to invade.

![Figure 1. The estimated distribution of lippia in the Condamine catchment.](image-url)
Lippia has not invaded its full range in the MDB, or probably in other parts of Australia. Nor has it reached stable densities or biomass in most MDB catchments.

 spread, by seed and vegetative propagules, and increase in cover is related to flood events. Lippia is spreading into hilly areas above flood levels and onto lighter soils. It remains to be seen how important it will be as an invader away from the heavy clay floodplains. The cost of lippia to the livestock grazing industry in the MDB is conservatively $38 million p.a. in lost production. There are additional significant costs related to herbicidal control, clearing, and infrastructure damage. From survey respondents with lippia, average de-stocking rate was 55%, and up to 100% in severely infested paddocks. Lippia is considered to be a major threat to riparian and associated ecosystems because of its dominance over native plants. It forms monocultures on otherwise undisturbed land. It is a significant threat to the Macquarie Marshes where it currently infests 10% of the reserve area, and to the numerous other wetlands in the MDB. Costs associated with loss of environmental services are estimated at $1800 million p.a. These include: loss of biodiversity; perennial vegetation and floodplain area; increased rates of erosion; and reduction in water quality.

Conventional methods of herbicide application and low density grazing management have provided no effective long-term suppression of the spread of lippia. Use of herbicide is restricted by proximity of susceptible crops and by the large areas of lippia occurring in riparian zones and inaccessible areas.

Lippia is managed by cultivation. Consequently there are pressures to clear and cultivate invaded forested land. Inundated floodplains that should be maintained as permanent pastures are being cultivated, leading to soil loss during flooding and other negative downstream effects. Such practice is not sustainable. In riparian areas there are no useful options for management.

RESEARCH AND MANAGEMENT PLANS

Recommendations for research and management of lippia, outlined by the initial stakeholder meeting in Narrabri in 2002, supported by the MDLG and detailed in Earl (2003) include the following.

1. Biological control may be the only option to control lippia on land that cannot be cultivated, and particularly on areas where other methods cannot be used, e.g. riparian zones. Surveys for potential agents have never been carried out. Co-investment funding is being sought with Meat and Livestock Australia (MLA) and the Natural Heritage Trust (NHT)/National Action Plan (NAP) to begin surveys in South America in mid 2005. A key question is: are there suitable and safe biological control agents for lippia?

2. The origin of *P. nodiflora* requires clarification. Some botanists have indicated that it could be native to Australia. This information has implications for management of lippia, particularly the selection of biological control agents. A key question is: what is the native range of *P. nodiflora*?

3. Ecology and phytochemistry. Key questions are: is allelopathy a key factor in lippia invasion and what other factors provide lippia with its competitive edge?

4. Under inundation lippia switches emphasis to vegetative reproduction through node growth and fragmentation, leading to water dispersal (Lucy et al. 1995). Lippia flowers prolifically but the seed banks appear to be small. Key questions include the following. What mechanisms control fragmentation? How important is nodal growth and fragmentation in population dispersal and growth? What mechanisms control seed production? How important is seed in its population dynamics? What other dispersal mechanisms contribute to spread?

5. Lippia is most abundant in the northern floodplains of the MDB; less so in the south where lower rainfall and different seasonal distribution of rain occurs. It is less tolerant of drought and saline soils than the native grass *Sporobolus mitchelli* (Trin.) S.T.Blake (Taylor 2003). Key questions are as follows. What are the environmental tolerance limits for lippia growth and reproduction? Is lippia a significant threat to southern MDB, upland areas and lighter soils?

6. Sites dominated by *S. mitchelli* differed from those dominated by lippia (Taylor 2003). Key questions are: what changes occur as a result of lippia invasions and are these reversible?

7. Colonisation of riparian zones with acceptable perennial plant species will be essential for stabilisation and erosion management. Poor soil structure and low levels of organics matter appear to favour lippia. Key questions include the following. How can we manage lippia and promote natural vegetation, especially in riparian areas? How can land threatened with invasion be ‘lippia proofed’? What is the relationship between lippia invasion, soil structure and soil quality, i.e. are poor soils...
advantageous for lippia or does lippia cause soil deterioration?

8. Awareness and education. Many landholders in the MDB are unaware of lippia and its potential impacts. This is largely because lippia has not yet reached their horizon of significant issues. It is essential that effective and practical land-proofing strategies against lippia are developed and publicised.

9. The recognition of lippia invasions as a threatening process for natural communities is being pursued. This will help draw attention to this invasive species, raise its profile in relation to conservation and endangered species, and may help increase resource levels.

10. Do grazing management practices, which have reportedly provided control of lippia in several situations, have wide practical and acceptable application?

CONCLUSION
There is an increasing recognition of the need to gain a better understanding of lippia and to develop practical management solutions. A project on lippia has been developed and incorporated in the Weeds CRC. The Weeds CRC has appointed a Ph.D. student to study aspects of ecology. The Cotton CRC will support operating costs. In addition the Weeds CRC has contributed half the cost of a Post Doctoral Researcher for three years to investigate ecology and management aspects of the weed. We are currently seeking support for the other half of the researcher and for surveys for biological control agents through co-investment with MLA, NHT regional group, MDB Commission, etc.

Awareness will play a critical role in managing lippia particularly in areas where it is not yet a serious issue. Raising awareness and implementing strategies against a potential problem will only be possible with effective community involvement. Unfortunately lippia is commonly grown as a lawn-grass substitute and a garden ornamental. It continues to be sold by plant nurseries. This stimulates sensitivities and causes ethical and practical dilemmas when people accept and grow a garden plant species that causes significant loss of income for nearby farmers and degrades environments.

The impact of the recent severe drought has decimated perennial grasses and other vegetation. The drought also restricted the growth of lippia but in many places it was the only remaining species. Following recent flood events, we anticipate that lippia will colonise widely and increase its density and biomass. It will meet very limited or no inter-specific competition in many areas. A significant increase in lippia distribution and density is expected in the short term.

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REFERENCES